PCT/GB2003/002663

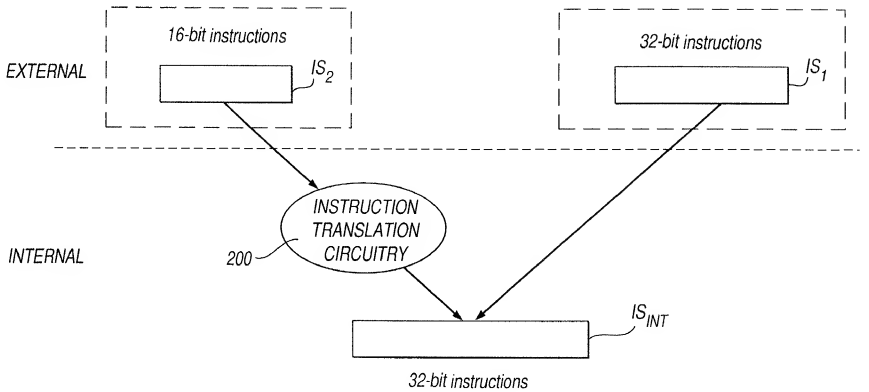

Fig.1

INSTRUCTION SETS FOR PROCESSORS
Nigel Peter Topham
Green, Blue & Topham, Ltd. (Patrick Burns)
Ref. No. 0808-6568
Sheet 1 of 16
(312) 360 0080

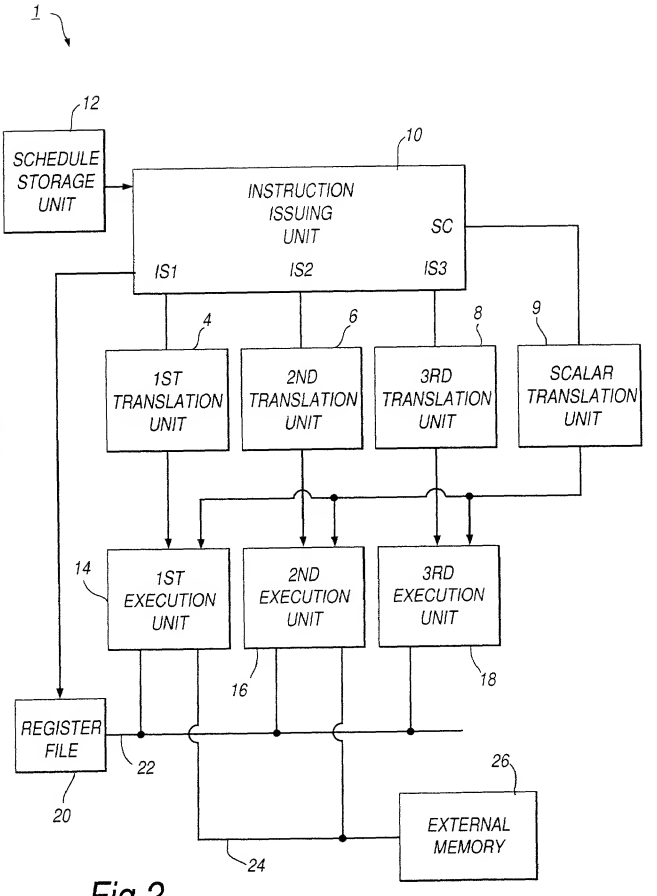
1
12
SCHEDULE STORAGE UNIT
10
INSTRUCTION ISSUING UNIT
SC
IS1
IS2
IS3
4
6
8
9
1ST TRANSLATION UNIT
2ND TRANSLATION UNIT
3RD TRANSLATION UNIT
SCALAR TRANSLATION UNIT
14
1ST EXECUTION UNIT
2ND EXECUTION UNIT
3RD EXECUTION UNIT
16
18
REGISTER FILE
22
20
26
EXTERNAL MEMORY
24

Fig.2

3/16

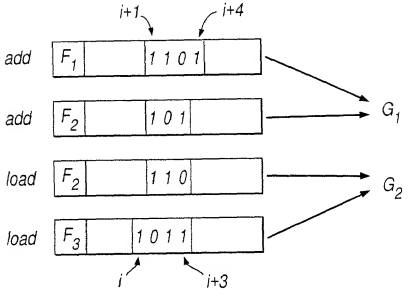

Fig.3(A)

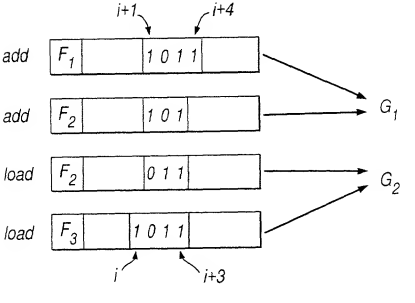

Fig.3(B)

4/16

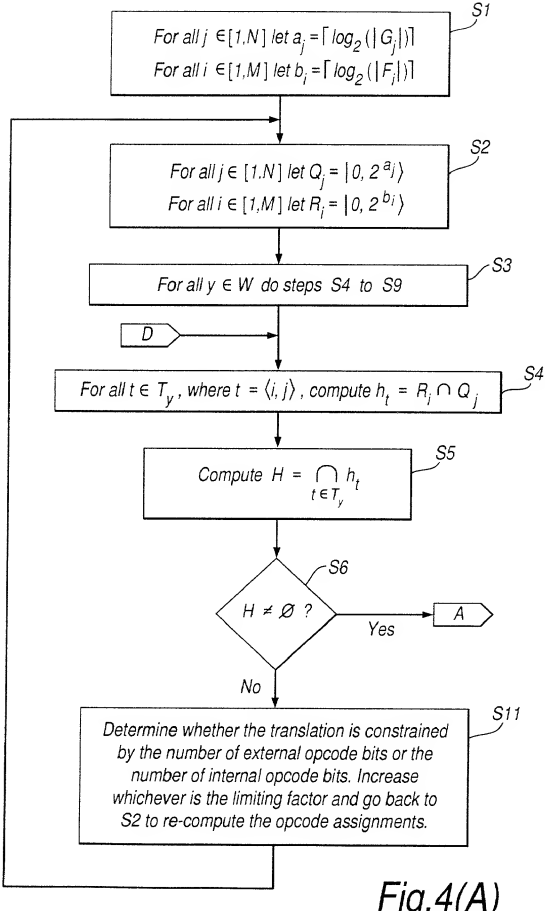
S1
For all j ∈[1,N] let $a_j = \lceil \log_2(|G_j|) \rceil$
For all i ∈[1,M] let $b_i = \lceil \log_2(|F_i|) \rceil$
S2
For all j ∈ [1.N] let $Q_j = |0, 2^{a_j}\rangle$
For all i ∈ [1,M] let $R_i = |0, 2^{b_i}\rangle$
S3
For all y ∈ W do steps S4 to S9
D
S4
For all t ∈ T_y, where t = ⟨i, j⟩, compute $h_t = R_i \cap Q_j$
S5
Compute $H = \bigcap_{t \in T_y} h_t$
S6
H ≠ Ø ?
Yes
A
No
S11
Determine whether the translation is constrained by the number of external opcode bits or the number of internal opcode bits. Increase whichever is the limiting factor and go back to S2 to re-compute the opcode assignments.

Fig.4(A)

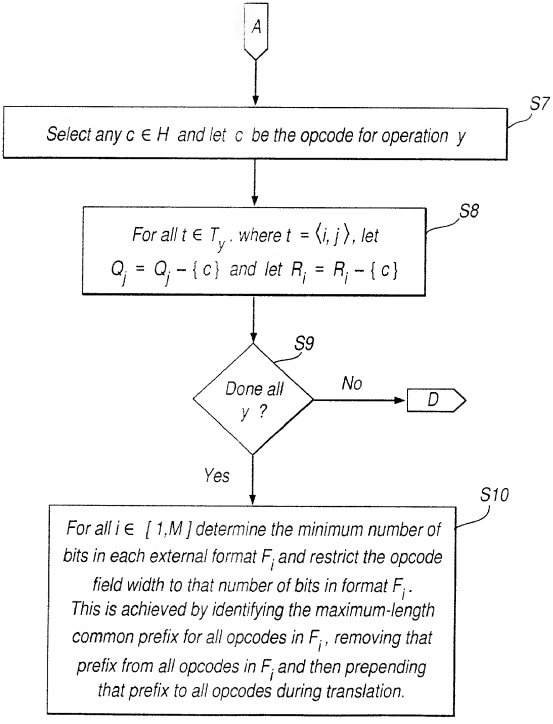
A
S7
Select any c ∈ H and let c be the opcode for operation y
S8
For all t ∈ T_y, where t = ⟨i, j⟩, let
Q_j = Q_j − {c} and let R_i = R_i − {c}
S9
Done all y ?
No
D
Yes
S10
For all i ∈ [1,M] determine the minimum number of bits in each external format F_i and restrict the opcode field width to that number of bits in format F_i. This is achieved by identifying the maximum-length common prefix for all opcodes in F_i, removing that prefix from all opcodes in F_i and then prepending that prefix to all opcodes during translation.

Fig.4(B)

PCT/GB2003/002625

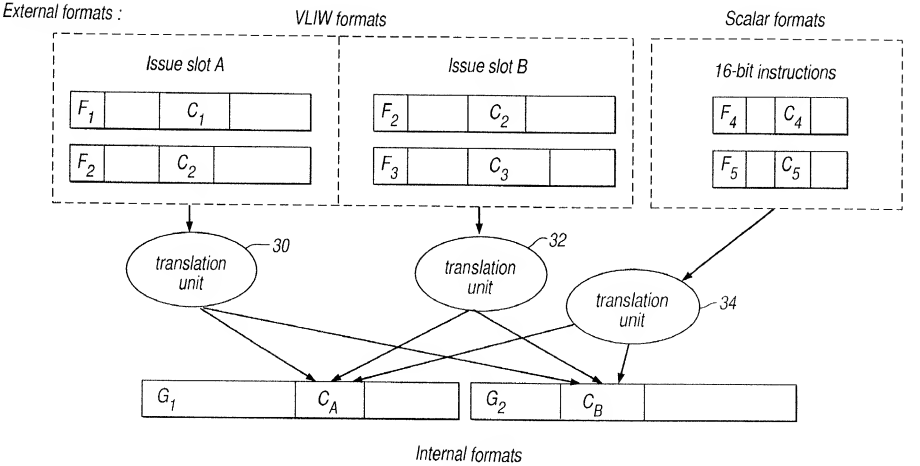

Fig.5

INSTRUCTION SETS FOR PROCESSORS
Nigel Peter Topham
Graser, Burns & Crain, Ltd. (Patrick Burns)
Reference: P0038GB
Sheet 6 of 16 (312) 360 0080

Operation	Internal format	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1						
	G_2						
or	G_1			*			
	G_2						
mul	G_1						
	G_2						
li	G_1						
	G_2						
sub	G_1						
	G_2						
rv	G_2						
div	G_2						

Fig.6

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1						
	G_2						
mul	G_1						
	G_2						
li	G_1						
	G_2						
sub	G_1						
	G_2						
rv	G_2						
div	G_2						

$R_1 = \{ 001, 010, 011 \}$
$R_2 = \{ 001, 010, 011 \}$
$R_3 = \{ 001, 010, 011, 100, 101, 110, 111 \}$
$R_4 = \{ 001, 010, 011 \}$
$R_5 = \{ 001, 010, 011, 100, 101, 110, 111 \}$
$Q_1 = \{ 001, 010, 011, 100, 101, 110, 111 \}$
$Q_2 = \{ 001, 010, 011, 100, 101, 110, 111 \}$

Fig.7(A)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1						
	G_2						
li	G_1						
	G_2						
sub	G_1						
	G_2						
rv	G_2						
div	G_2						

$R_1 = \{ 010, 011 \}$
$R_2 = \{ 010, 011 \}$
$R_3 = \{ 010, 011, 100, 101, 110, 111 \}$
$R_4 = \{ 010, 011 \}$
$R_5 = \{ 010, 011, 100, 101, 110, 111 \}$
$Q_1 = \{ 010, 011, 100, 101, 110, 111 \}$
$Q_2 = \{ 010, 011, 100, 101, 110, 111 \}$

Fig.7(B)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1	010	010	010	010		
	G_2	010	010			010	010
li	G_1						
	G_2						
sub	G_1						
	G_2						
rv	G_2						
div	G_2						

$R_1 = \{ 011 \}$
$R_2 = \{ 011 \}$
$R_3 = \{ 011, 100, 101, 110, 111 \}$
$R_4 = \{ 011 \}$
$R_5 = \{ 011, 100, 101, 110, 111 \}$
$Q_1 = \{ 011, 100, 101, 110, 111 \}$
$Q_2 = \{ 011, 100, 101, 110, 111 \}$

Fig.7(C)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1	010	010	010	010		
	G_2	010	010			010	010
li	G_1	011			011		
	G_2	011				011	
sub	G_1						
	G_2						
rv	G_2						
div	G_2						

$R_1 = \{ 011 \}$
$R_2 = \{ \}$
$R_3 = \{ 011, 100, 101, 110, 111 \}$
$R_4 = \{ \}$
$R_5 = \{ 011, 100, 101, 110, 111 \}$
$Q_1 = \{ 100, 101, 110, 111 \}$
$Q_2 = \{ 100, 101, 110, 111 \}$

Fig.7(D)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1	010	010	010	010		
	G_2	010	010			010	010
li	G_1	011			011		
	G_2	011				011	
sub	G_1						
	G_2						
rv	G_2						
div	G_2						

$R_1 = \{ 011, 100, 101, 110, 111 \}$
$R_2 = \{ \}$
$R_3 = \{ 011, 100, 101, 110, 111 \}$
$R_4 = \{ \}$
$R_5 = \{ 011, 100, 101, 110, 111 \}$
$Q_1 = \{ 100, 101, 110, 111 \}$
$Q_2 = \{ 100, 101, 110, 111 \}$

Fig.7(E)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1	010	010	010	010		
	G_2	010	010			010	010
li	G_1	011			011		
	G_2	011				011	
sub	G_1		100	100			
	G_2		100				100
rv	G_2						
div	G_2						

$R_1 = \{ 011, 101, 110, 111 \}$
$R_2 = \{ \}$
$R_3 = \{ 011, 101, 110, 111 \}$
$R_4 = \{ \}$
$R_5 = \{ 011, 101, 110, 111 \}$
$Q_1 = \{ 101, 110, 111 \}$
$Q_2 = \{ 101, 110, 111 \}$

Fig.7(F)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1	010	010	010	010		
	G_2	010	010			010	010
li	G_1	011			011		
	G_2	011				011	
sub	G_1		100	100			
	G_2		100				100
rv	G_2						101
div	G_2						

$R_1 = \{ 011, 101, 110, 111 \}$
$R_2 = \{ \}$
$R_3 = \{ 011, 110, 111 \}$
$R_4 = \{ \}$
$R_5 = \{ 011, 101, 110, 111 \}$
$Q_1 = \{ 101, 110, 111 \}$
$Q_2 = \{ 110, 111 \}$

Fig.7(G)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	000	000	000	000		
	G_2	000	000			000	000
or	G_1	001	001	001	001		
	G_2	001	001			001	001
mul	G_1	010	010	010	010		
	G_2	010	010			010	010
li	G_1	011			011		
	G_2	011				011	
sub	G_1		100	100			
	G_2		100				100
rv	G_2						101
div	G_2		110				110

$R_1 = \{ 011, 101, 110, 111 \}$
$R_2 = \{ \}$
$R_3 = \{ 011, 111 \}$
$R_4 = \{ \}$
$R_5 = \{ 011, 101, 111 \}$
$Q_1 = \{ 101, 110, 111 \}$
$Q_2 = \{ 111 \}$

Fig.7(H)

Operation	Internal formats	External formats (Scalar)		External formats (VLIW)			
				Issue slot A		Issue slot B	
		F_4	F_5	F_1	F_2	F_2	F_3
add	G_1	00	000	000	00		
	G_2	00	000			00	000
or	G_1	01	001	001	01		
	G_2	01	001			01	001
mul	G_1	10	010	010	10		
	G_2	10	010			10	010
li	G_1	11			11		
	G_2	11				11	
sub	G_1		100	100			
	G_2		100				100
rv	G_2						101
div	G_2		110				110

$R_1 = \{ 011, 101, 110, 111 \}$
$R_2 = \{ \}$
$R_3 = \{ 011, 111 \}$
$R_4 = \{ \}$
$R_5 = \{ 011, 101, 111 \}$
$Q_1 = \{ 101, 110, 111 \}$
$Q_2 = \{ 111 \}$

Fig.8